IN-STOPE ATOMISATION FOR DUST SUPPRESSION LP

COPA MEETING

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14th of August 2025, MS Teams

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Agenda

1. SAMI Dust Risk Mitigation Strategy (Critical Control Management)
    - ✓ Challenges in Achieving OH Milestones
    - ✓ Areas of Focus *(Doing things differently)*
2. LP Background
3. Practice Elements to be Adopted
4. Critical Success Factors for Adoption
5. Unintended Consequences
6. Questions??

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SAMI STRATEGIC APPROACH

Summary of 2014 industry milestone performance

Respirable Crystalline Silica

- Industry performance end 2023 was **5,2%** of samples >0,05mg/m³
- Gold Commodity performance end 2023 was **11,4%** samples >0,05mg/m³

Respirable Platinum Dust

- Industry performance end 2023 was **0,8%** of samples >1,5mg/m³

Respirable Coal Dust

- Industry performance end 2023 was **8,4%** of samples >1,5mg/m³
- Underground Coal Mines have a significant challenge

Elimination of Occupational Lung Diseases

- **8 cases** of silicosis in novices reported

Source: Minerals Council South Africa

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Key Challenges on Milestone Achievement - DUST

- Slow uptake of adoption of Leading Practices
- Inadequate support from senior management for the Adoption of Leading Practices
- Poor maintenance of the control measures implemented
- Lack of monitoring of the effectiveness of controls
- Measurement of dust and quality of data sub-optimal
- Inadequate supervision of employees
- Unwanted Employee Behaviour such as non-adherence to standards and procedures
- Physical/environmental conditions (heat) not conducive to constant wearing of dust masks

Other Challenges - DUST

- Frequent changes in Mine Adoption Team Managers and Mine Adoption Teams impacting continuity.
- Slow uptake of leading practice adoption.
- Change from one company structure to another (adapting to new corporate culture)
- Adoption vs implementation
- Lack of multi-disciplinary approach

“ The opportunity to do things differently to achieve OH Milestones”

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MINING INDUSTRY DUST CONTROL & MANAGEMENT STRATEGY

Multidisciplinary approach to addressing exposures, risks and controls.

Better root cause analysis (Dust Risk Bowties) and critical control management with control owners assigned *(See MOSH Dust Webpage)*

Adoption of MOSH Leading Practices

Control Performance Evaluation & Monitoring (CRTM)

Promote automation and innovation to eliminate dust exposures

Robust OEM (Dust Suppression) engagement strategies (A consolidated approach)

Continuous identification, facilitation and dissemination of research.

Promote learning from others. Participation in industry forums, workshops, LP COPA Meetings

Improve dust and noise measurement and reporting skills.

Develop awareness & educational material on dust and dangers of mining exposures. *(Visit MOSH Website)*

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LP BACKGROUND

Background

- 2024 MHSC Milestones:

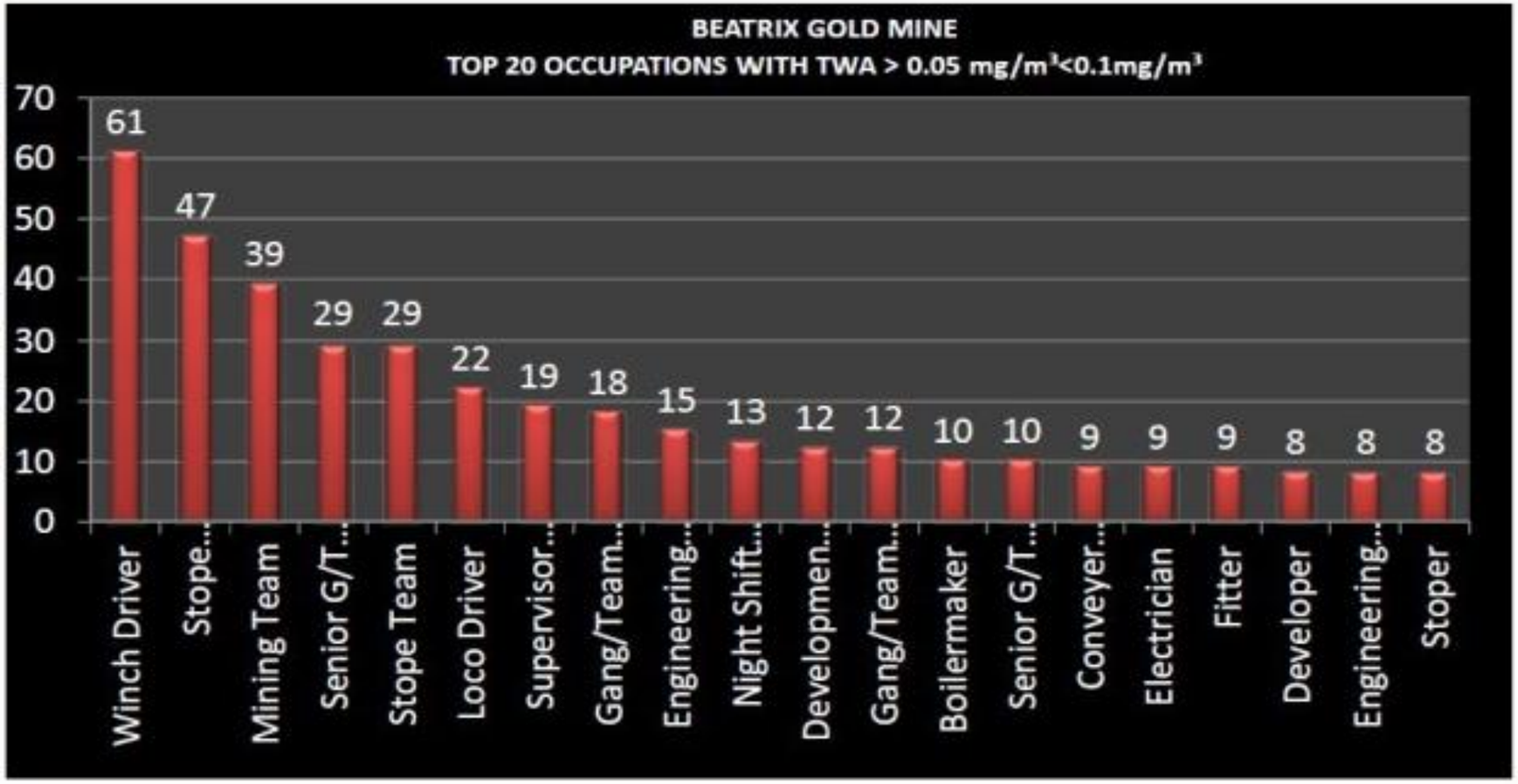
Industry Target: Elimination of Silicosis

- By December 2024, 95% of all exposure measurement results will be below the milestone level for respirable crystalline silica of 0.05 mg/m3 *(these are individual readings - not average results).*
- Using present diagnostic techniques, no new cases of silicosis will occur amongst previously unexposed individuals *("These are those unexposed to mining dust prior to December 2008 I.e. equivalent to a new persons who entered the industry in 2009)*

- Stope areas in gold mines pose a higher risk of exposure to airborne silica dust
- Several interventions introduced as part of Beatrix Mine's initiative to achieve Zero Harm
  - ✓ Conducted a study to identify the more effective practices, as well as to identify additional controls that could be used within the stope area
  - ✓ During the second part of the study, the value of implementing an in-stope water-blast was investigated. This was the birth of **The In-Stope Atomizer for Dust Suppression**

Background

Top 20 exposed occupations



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The Problem Addressed

- ✓ Dust liberated during scraping activities in a mine stoping panel travels with the ventilating air and may affect any employee working downstream of the ventilation.
- ✓ Most hard-rock stopes are ventilated in series (utilizing the same air stream) due to conventional mining methods. Therefore, any dust liberated from the furthest stope upstream (Intake side) will also affect next stope in series, and the next, thus exposing any employees working in the ventilation route (district) to respirable dust. Employees working at the stoping face, vamping stope, development ends and at areas near stoping and vamping activity are most affected by such dust exposure.
- ✓ In-Stope Atomization aims to primarily prevent respirable dust from getting airborne and removing airborne dust from the ventilating air by deploying fine water droplets at high velocity to capture dust particles, thus reducing the amount of dust liberated by scraping activities and ensuring cleaner ventilating air.
- ✓ The benefit of this reduction in dust level can have significant impact on the total ventilating air quality at any operation, thus reducing the total respirable dust exposure of employees in that operation.

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Strategic Context

- **Dust Suppression Approaches**

- Some of the most effective methods to dust control & reducing the exposure of employees to respirable dust emanating from mining activity is to :

✓ ***Prevent the respirable dust from getting airborne***
✓ ***Removing dust from the ventilating air***

- Suppression of dust using water based methods is a globally known and applied phenomenon.
- Water sprays of varying designs have been used for different applications within the SAMI (South African Mining Industry).
- Use of Water sprays has yielded different result in terms of their effectiveness, efficiency as well as their principle of operation.

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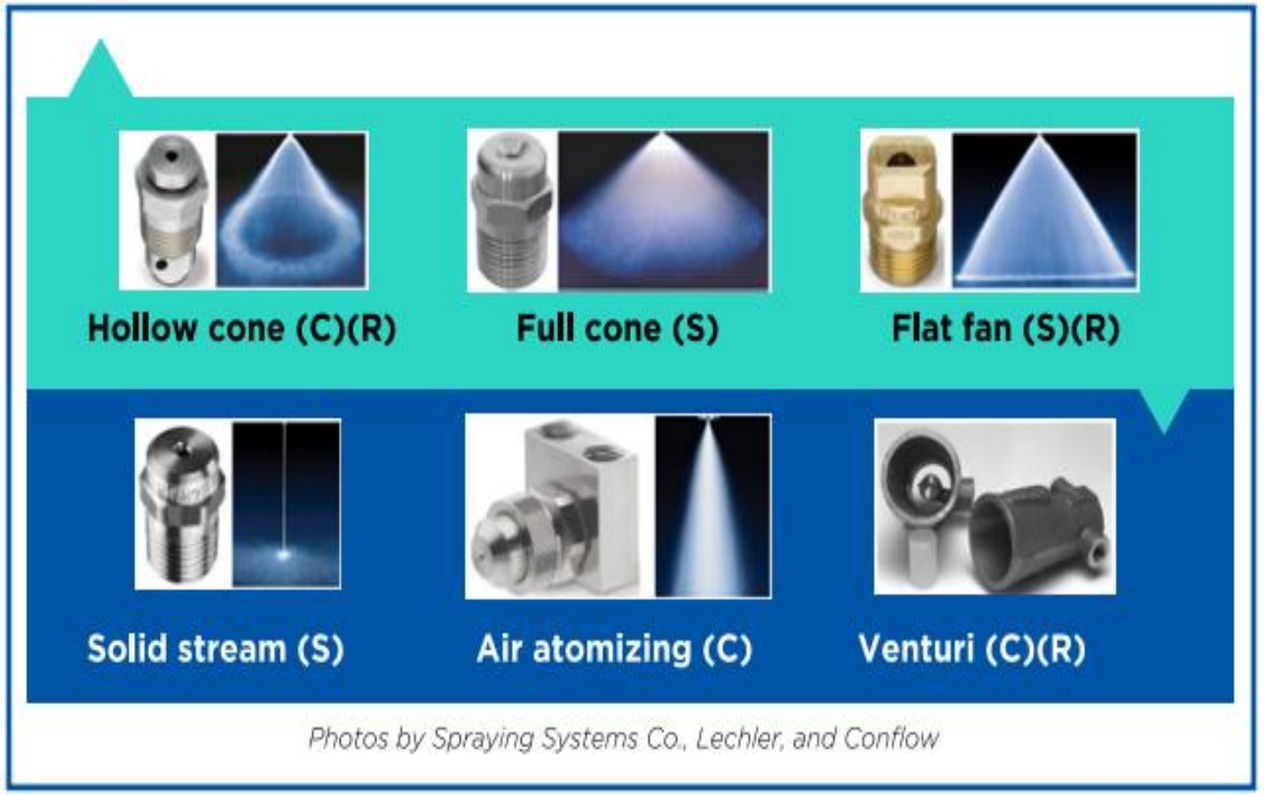
Atomisation

- Atomisation is a process of transforming bulk liquid or water droplets, into fine and smaller liquid droplets (spray/mist) in a surrounding gas or vacuum using increased air pressure. Small water droplets travelling at high velocity have proven to be more effective in capturing dust particles.

Impact of Water Sprays for Dust Control • Suppression (S) - prevent dust from getting airborne. • Capture (C) - remove dust from ventilating air. • Redirect airflow (R) - direct dust away from workers



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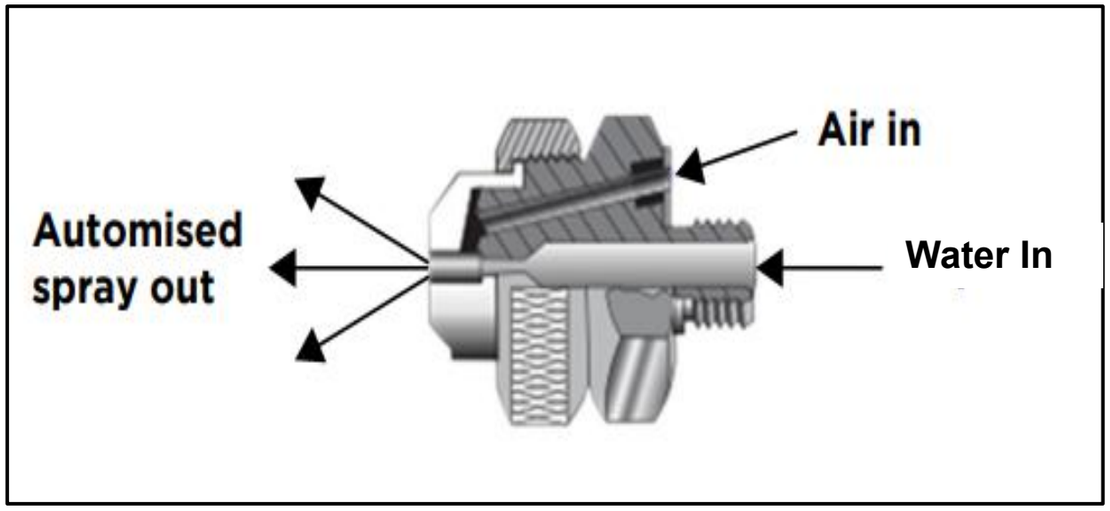
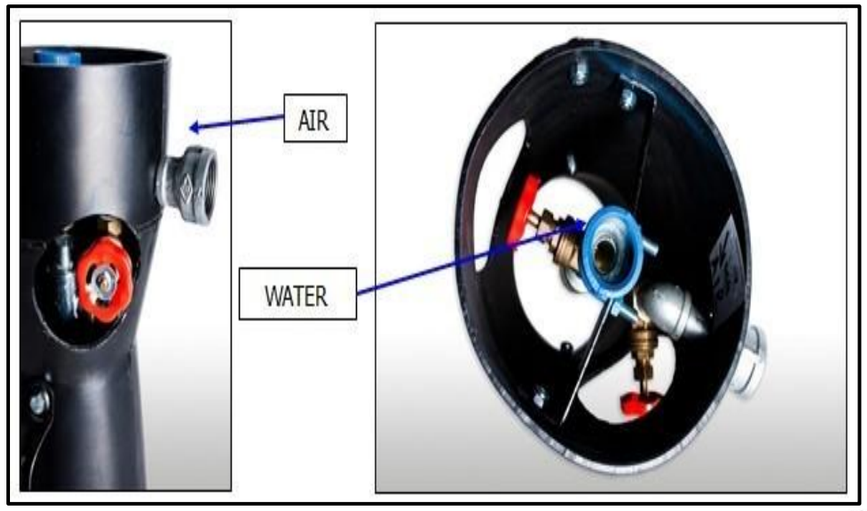
Details of In-Stope Atomization

- **Principle of operation:**
  - ✓ Use of a water atomizing device to capture airborne dust particles.
  - ✓ Each unit is equipped with two valves to regulate water and compressed air through a housed orifice/nozzle.
  - ✓ Unit requires an 8mm sized nozzle to achieve atomization.
  - ✓ Air supply must be between 4 and 6kPa to reach optimal operating point.





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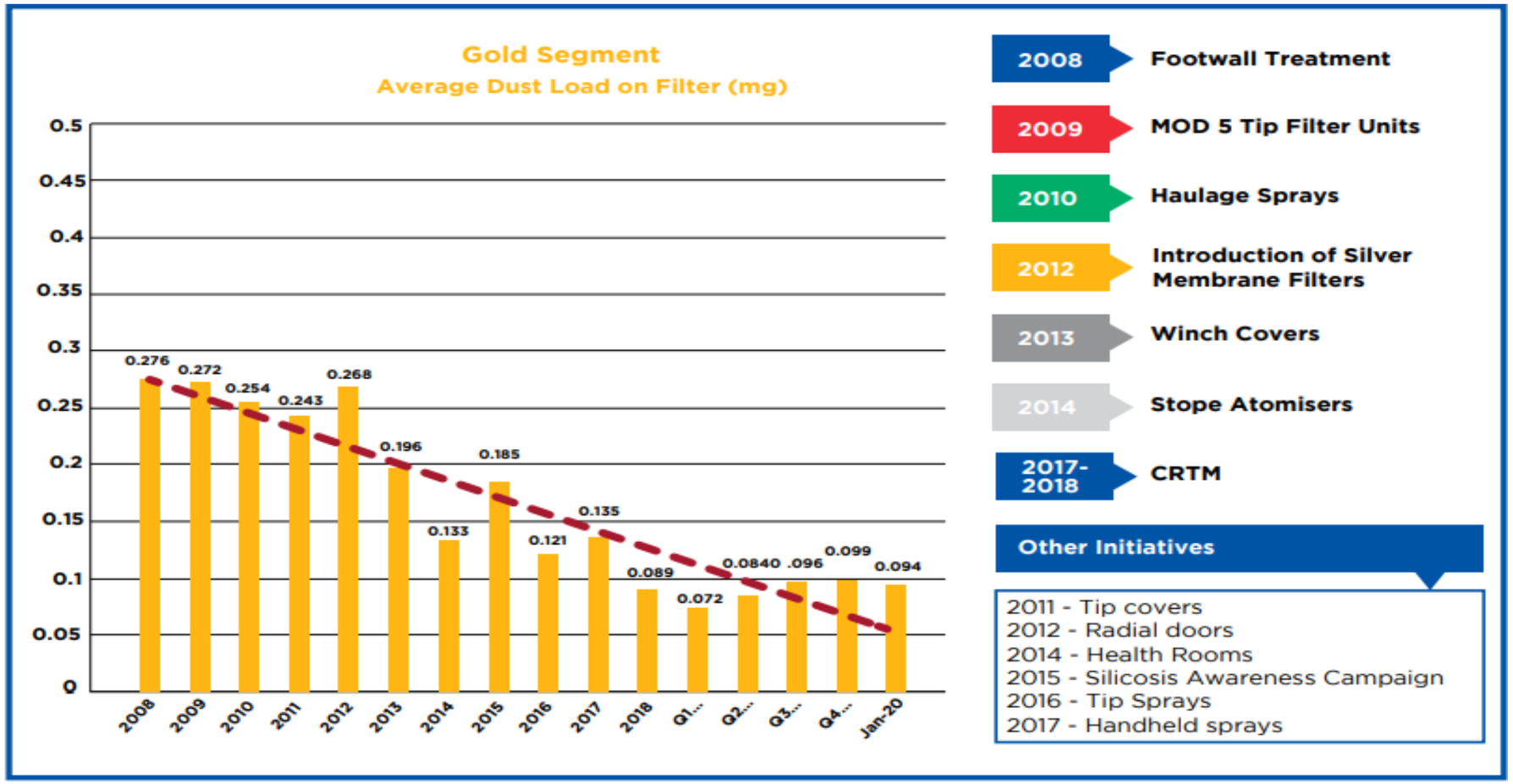
Summary of Documented Performance & Impacts

- **Dust Results - Group:**



Source Mine Group average dust load on filter (2008- 2020)

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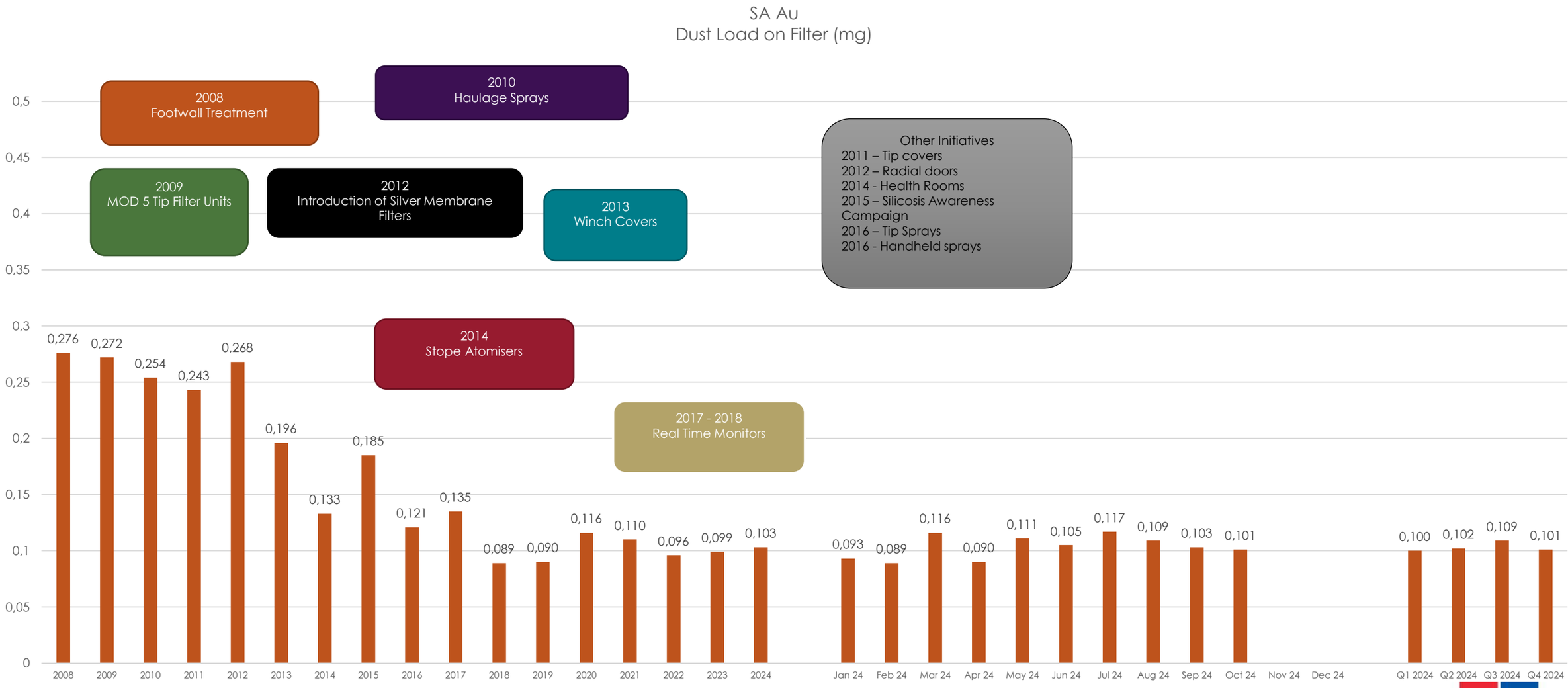
Airborne Pollutants - Dust Load on Filter



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Summary Description of Practice

- ✓ The practice is currently applied/used at all source mine operations as one of their critical engineering controls to eliminate or mitigate against the risk of dust exposure emanating from activities such as **scraping** of ore during stope face cleaning after the blast, stope **panel sweeping, vamping** and general **ore conveyance**.
- ✓ The practice involves installation of an “In-Stope Atomising unit” at strategic positions of the stope. The device is designed to capture airborne dust particles to prevent employee exposure to harmful airborne pollutants.
- ✓ The “In-Stope Atomising Unit” works on a principle of mixing compressed air (high pressure) and water, deployed into the atmosphere to form an atomized mist travelling at high velocity to capture the airborne dust particles efficiently. The “In-Stope Atomising Unit” has two separate inlets where water and compressed air can be connected to the device using hoses.
- ✓ The device is **manually activated** by opening the compressed air and water valves until an atomized mist is attained. The device is usually activated before dust liberating activities such scraping commence in a stope (and not to be used continuously for the entire shift duration).

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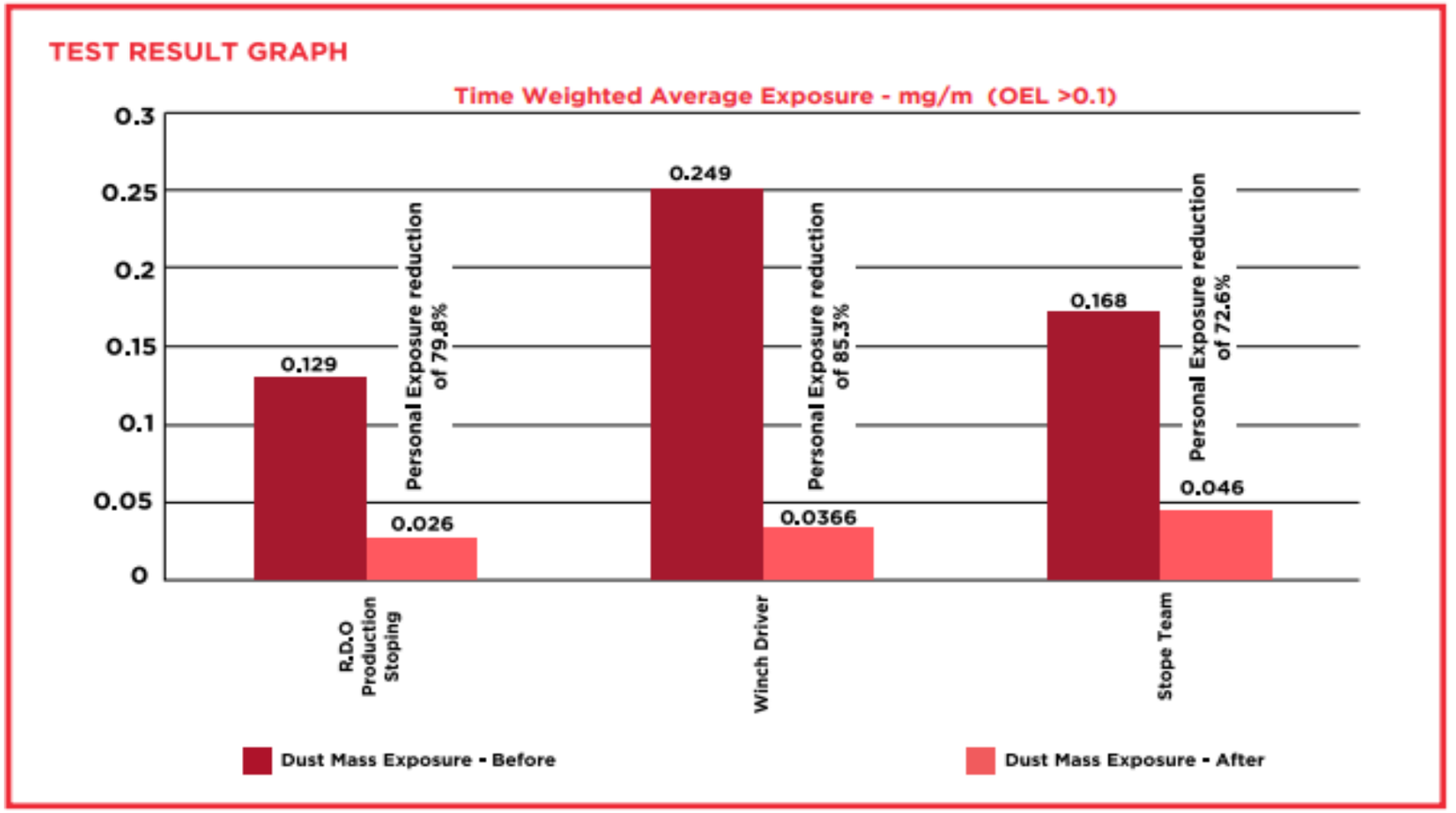
Source Mine Value Case

FISCAL	**Initial Cost**	The cost of a single unit (In-Stope Atomiser) at the source mine was estimated to be approximately R1500 and can be purchased off the shelf. The practice bears no installation cost as it uses the water and compressed air manifolds which are already available at the stoping face.
	Maintenance & Operational Costs	No Maintenance required on the unit. The device is used to destruction. The only component of the unit that can be replaced if damaged is the housing. The mine can choose if this is feasible to do or not. The Original Equipment Manufacturer (OEM) at the source mine, estimates this replacement to be between R300 – R400 per unit
HEALTH & SAFETY	OHS Benefit	The risk of occupational lung diseases to underground employees will be significantly reduced. This is of real value to both employees and management.
	Progress towards Zero Harm	Death from silicosis and other occupational lung diseases caused by excessive exposure to silica dust is the greatest cause of mortality in mine workers. Reducing this risk to underground employees most at risk will constitute a significant step towards achieving the ultimate goal of zero harm.
STAKEHOLDER RELATIONS	Improved Working Relationships	Implementation of the behavioral communication and leadership behavior plans has the potential to significantly improve the operational working relationship between supervisors and their staff.
	Buy-in and Support.	The mine-wide intervention in the interest of protecting the health of those most at risk will help engender buy-in and support for the intervention, from employees and relevant stakeholders.
	Improved Investor Relations	A positive outlook on the mine's commitment towards elimination of Occupational Lung Diseases.
GOVERNANCE	Legal Compliance	The installation & use of In-Stope Atomising units will assist in meeting regulated permissible dust exposure levels. It will also be a good case of management doing what is reasonably practicable to provide and maintain a working environment that is safe and without risk to the health of all underground employees
	Reduced Compensation	In the longer term the mining industry, including the mine, will benefit from a reduction in compensation and other costs associated with silicosis

Source Mine Benefits

Source Mine Benefits

Dust Results



Average Time Weighted Exposure (TWA) over eight-week period

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Source Mine Benefits

Additional Benefits of In-Stope Atomization for Dust Suppression

- ✓ Portable to use: 500mm x 200mm diameter.
- ✓ Lightweight and easy to carry or move, 3.0kg – 4.6kg.
- ✓ Robust design for blast concussive environments and reduced water/air blockages.
- ✓ The unit requires no maintenance as it is being used to destruction.
- ✓ Economical water and compressed air consumption

LP Elements to be Adopted

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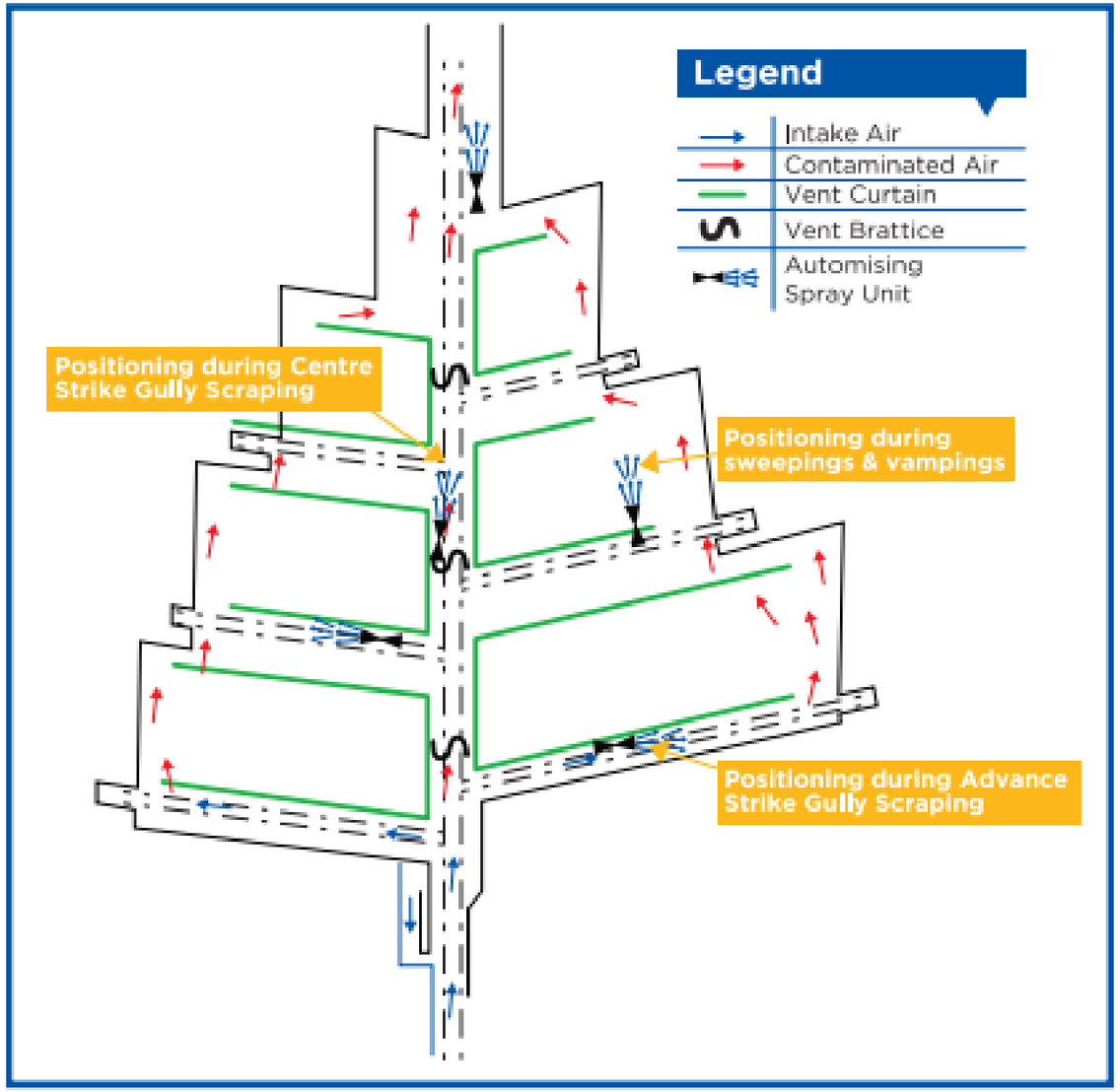
Ventilation Layout

The “In-Stope Atomising unit” is installed on:

- The air intake side of the stoping panel one unit per panel is adequate.
- The unit is generally easy to install operation and the installation can be done by any of the stoping crew members.
- A layout to be issued by the VOHE department.
- The Miner to interpret the layout and explain the positioning of the units to the crew.
- Adherence to a ventilation layout is of utmost importance.
- The VOHE to monitor the correct positioning and use of the units.



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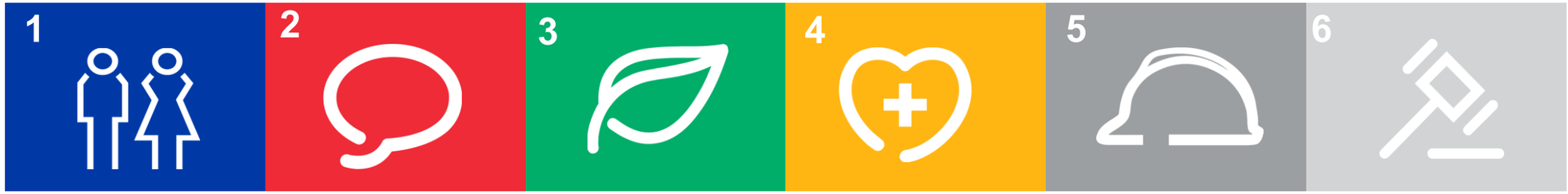
LP Elements to be Adopted

Installation



Risk Assessment	Suitable Site	Position of Unit	Water Connection	Compressed Air Supply	Operation
Conduct a pre installation risk assessment addressing the hang support, mobile equipment operating in the vicinity and the required PPE to be used during installation of the stope atomizing unit.	Select a suitable site to install the stope atomizing unit where the maximum spray cover of the area can be obtained. The site must have access to both water and compressed air connections.	Position the stope atomizing unit to spray in the direction of the airflow (increased contact time) using the bracket.	Connect the water supply from the manifold to the atomizing unit using hoses. Ensure that the safety sling is attached to the compressed air hose prior to operating the unit.	Open the compressed air valve on the atomizing unit fully to ensure maximum water atomization.	Open and adjust the water supply valve on the atomizing unit to attain an atomized mist and optimal spray coverage across the area where installed.

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LP Elements to be Adopted

Supervision & Over-Inspection

- The Miner must inspect the installation, positioning and use of each of the atomizing units
- that are in use during a particular shift.
- The Miner to provide continuous coaching on challenges experienced.
- The Shift Supervisor to ensure that the units are used for the intended purposes and that maximum benefit is drawn in terms of reducing the dust load

- **Behavioral Communication**
- The mine must establish platforms to communicate messages or to educate employees on a healthy and safe working environment.
- It is during this 14 MINERALS COUNCIL SOUTH AFRICA session where all employees are mobilized to join the fight against silicosis and other occupational lung diseases.
- This can only be achieved if employees understand the dangers of silica dust causing silicosis.
- The source mine has set up an underground health room (Underground Mock-up training Centre) for this purpose.

LP Elements to be Adopted

Leadership Behavior

- Measurement, assessment, and corrective actions where necessary.
- Development and continuous improvement of critical controls of airborne pollutants at source and elsewhere.
- Training and education of employees.
- Initiate awareness campaigns.
- Establish communication platforms.
- Enforcement of dust control procedures.
- Develop and live a set of values towards eradication of silicosis.

Training

- Employee training on the installation and use of the unit (production crew).
- Training during annual refresher training.
- Continuous coaching.
- Planned Task Observations to be conducted by line supervisor.

LP Elements to be Adopted

Cost

- The cost of a single unit at the source mine is estimated to be approximately R1500
- Can be purchased off the shelve.
- The practice bears no installation cost as it uses the water and compressed

Availability & Sustainability

- Keep sufficient and enough stocks of the units at the mine stores
- Stock for new installations or exchange of damaged units.
- This will assist in sustaining the leading practice at an operation

Critical Success Factors

Critical Success Factors

1. Top management buy-in and support
2. A credible adoption champion with adequate time and support
3. Proper identification, briefing and training of key people
4. A well designed and executed adoption roll-out plan

Unintended Consequences

Unintended Consequences

- ✓ Unit used as a ventilation appliance to improve air velocity and cooling.
- ✓ Used for watering down.
- ✓ Used for the entire duration of the shift.

ADOPTION GUIDANCE

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Adoption Steps

1 Facilitate Adoption Decision

- Assess the risk at the operation
- Decide on the case for adoption of leading practice
- Top Management understanding and buy-in

2 Secure Support for Adoption

- Make use of available communication means
- Cover all stakeholders
- Key elements being communicated

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Adoption Steps

3 Establish Mine Adoption Team

- Champion appointment
- Technical and behavioural elements of the practice
- Multi-disciplinary team
- Adoption and Communication to all stakeholders

4 Prepare Plan for Adoption

- Site selection for pilot
- Site to be meaningful and accessible
- Timelines for adoptions
- Resource requirements

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Adoption Steps

5 Initiate Baseline Monitoring Programme

- Identification and planning of the monitoring process
- Key measurements needed to quantitatively indicate the performance
- Consideration should be given to measuring parameters or relevant OHS indicators
- The involvement of the VOHE team is crucial during this step

6 Establish Effective Relationship with the COPA

- Feedback on implementation challenges / successes
- Meetings are an ongoing activity
- Occur at frequencies determined by the members

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Adoption Steps

7 Update Key Stakeholders on Progress

- Prepare and issue progress updates to key stakeholders
- Updates should be prepared and issued regularly to Union leaders, mine management, and the MOSH
- Progress on the adoption process should be reported to and discussed with the Mine Manager at least once per month

8 Harmonise LP with Mine Standards

- Operational details of the LP must be reviewed in relation to mine standards to identify any potential conflicts or operational problems.
- Identify non-core adjustments to harmonize practice with mine standards
- If possible, this should be done before initiating the full piloting process

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Adoption Steps

9 Develop Training and Communication Materials

- Customised leadership behaviour and behavioural communication plans
- Any special training requirements identified by OEM or other service providers
- The mine's existing training arrangements should also be considered
- A schedule of who is to receive what training and when should be developed and agreed upon

10 Brief and Train Key Mine Persons

- The MAC should agree on arrangements for briefing supervisors and workers involved
- The briefings should be held soon after identifying the key stakeholders and adopters involved
- Initiate the training process according to the training programme that has been developed
- Follow-up on the training programme according to plan

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Adoption Steps

11 Monitor, Evaluate and Report performance

- The MAC to ensure that effective arrangements are put in place for making and recording the necessary measurements.
- The MAC must ensure consistent implementation of the monitoring and reporting
- Data analyses to establish the performance and impact of the practice

12 Implement mine wide roll-out plan

- As soon as the leading practice is working satisfactorily at the pilot site(s)
- The roll-out process should be initiated
- This should begin with a critical review of the roll-out plans developed
- Identify any adjustments that may need to be made

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Thank you

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